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**PATENT APPLICATION**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re application of

Docket No: Q57649

Christian F. M. DUJARRIC

Appln. No.: 09/492,749

Group Art Unit: 3746

Confirmation No.: 1328

Examiner: E. Gartenberg

Filed: January 27, 2000

For: A PROPULSION DEVICE, IN PARTICULAR FOR A ROCKET

**SUBMISSION OF APPELLANT'S BRIEF ON APPEAL**

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**MAIL STOP APPEAL BRIEF - PATENTS**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

SEP 26 2003

TECHNOLOGY CENTER R3700

Sir:

Submitted herewith please find an original and two copies of Appellant's Brief on Appeal. A check for the statutory fee of \$320.00 is attached. The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account. A duplicate copy of this paper is attached.

Respectfully submitted,

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Date: September 22, 2003



*S. Rattle*  
9/29/03

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APPELLANTS' BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

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^ Sir:

In accordance with the provisions of 37 C.F.R. § 1.192, Appellant submits the following:

I. REAL PARTY IN INTEREST

The real party in interest is AGENCE SPATIALE EUROPEENNE by virtue of an assignment executed by Christian F. M. DUJARRIC (Appellant, hereafter), on December 13, 1999 and recorded in the U.S. Patent and Trademark Office on January 27, 2000 at Reel 010550, Frame 0981.

II. RELATED APPEALS AND INTERFERENCES

To the best of the knowledge and belief of Appellant, the Assignee and the undersigned, there are no other appeals or interferences before the Board of Appeals and Interferences (the Board") that will directly affect or be affected by the Board's decision in the present Appeal.

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**III. STATUS OF CLAIMS**

Claims 4-8 and 14 are pending and are the subject of this appeal. Claims 1-3 and 9-13 have been canceled without prejudice or disclaimer.

**IV. STATUS OF AMENDMENTS**

No amendments have been submitted after the final rejection of the claims in the February 19, 2003 Office Action.

**V. SUMMARY OF THE INVENTION**

The Appellant's invention relates to a propulsion device (see Abstract, first sentence). One use for this propulsion device, although not limiting, is for rocket propulsion (see specification, page 1, lines 1-4). More particularly, the propulsion device includes an injection chamber disposed upstream from a gas injection nozzle, an inductive coil surrounding a zone of the injection nozzle, and a high frequency electricity generator providing power to the inductive coil (see page 5, lines 9-15 and independent claim 14). As a result of this configuration, one of Appellant's objects is to overcome, at least in part, the limits of known propulsion systems regarding specific impulse and/or technological constraints on temperature and/or energy efficiency (see specification, page 6, lines 5-8).

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Referring to Figure 1 of the application, one embodiment of the invention is depicted as a propulsion system of the induction nuclear chemical type.<sup>1</sup> The propulsion system has a hydrogen circuit 20 which comprises a duct 21 for feeding hydrogen to a pump 10 which feeds a duct 22 and whose outlet is connected to the inlet of a cooling circuit 12 for cooling an electricity generator 11. The cooling circuit 12 has an outlet connected to a duct 23 which feeds a pump 14 which directs hydrogen via a duct 24 causing it to pass through a heat exchanger 17 where it serves as a heat sink for a heat engine 18, after which, in order to be heated, a duct 25 causes it to pass through a heat exchanger 29 of a nuclear core 19 which serves as a heat source for the heat engine 18. Downstream from the nuclear core 19, the duct 26 directs the gaseous hydrogen to a duct 27 for feeding an injection chamber 5 disposed upstream from a nozzle 1 which has a throat 3 and which flares progressively at 6 and at 7, the flared regions 6 and 7 being separated by a region 4 in which an induction loop 8 is disposed, the loop 8 being powered via a power line 9 by the electricity generator 11 which produces electricity at high frequency (e.g. of the order of several tens of kHz), which electricity can have a waveform that is sinusoidal, in particular, and more particularly sinusoidal and of constant amplitude, or more generally it can have any waveform suitable for producing heating by induction.

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<sup>1</sup> Other embodiments of the invention disclosed in the specification include an induction nuclear chemical propulsion design (see specification, starting at page 14, line 3, and Figure 2); an induction nuclear chemical propulsion device with direct injection (see specification, starting at page 17, line 28, and Figure 3); an induction nuclear thermal device (see specification starting at page 20, line 26, and Figure 4); and an induction nuclear thermal propulsion device with a closed power generator loop (see page 22, starting at line 22, and Figure 5).

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The conversion of the heat as produced by the loop 8 and communicated to the plasma is then converted into thrust in the flared region 7 situated downstream from the induction loop 8. The heat engine 18 whose heat source is the nuclear core 19, and whose heat sinks are the hydrogen and the oxygen passing through the heat exchanger 17 is coupled to a shaft 15 which drives the pumps 10 and 14 for circulating hydrogen, the electricity generator 11, and a pump 16 for circulating oxygen.

**VI. ISSUES**

1. Whether the invention recited in claims 4-8 and 14 is directed to non-statutory subject matter that is against public policy as codified in 35 U.S.C. § 101. 2. Whether claims 4-8 and 14 are non-enabling under 35 U.S.C. § 112, first paragraph. 3. Whether claim 14 is anticipated by Curtiss et al. (U.S. Patent No. 3,173,248). 4. Whether claims 4 and 5 are unpatentable over Curtiss et al. in view of Oberly (U.S. Patent No. 4,739,200). 5. Whether claims 6-8 are unpatentable over Curtiss et al. in view of Oberly and further in view of Appellant's admissions regarding the related art.

**VII. GROUPING OF CLAIMS**

Under the 35 U.S.C § 101 rejection, claims 4-8 and 14 stand or fall together. Claim 14 as an independent claim stands by itself with respect to the rejection under 35 U.S.C. § 102(b). Claims 4 and 5 stand by themselves independently with respect to the rejection under 35 U.S.C. § 103(a). Finally, claims 6-8 stand or fall together with respect to their rejection under 35 U.S.C. § 103(a).

**VIII. ARGUMENTS**

**A. The claims are patentable subject matter under 35 U.S.C. § 101**

Claims 4-8 and 14 stand finally rejected under 35 U.S.C. § 101 due to being allegedly directed to non-statutory subject matter. More specifically, the Examiner asserts that claims 4-8 and 14 are non-statutory based on the United States National Space Policy, and in particular, a White House National Space Policy Fact Sheet. The Examiner newly notes in the latest Office Action of February 19, 2003, that as of February 12, 2003, this policy has not changed. For at least the reasons discussed herein, Appellant respectfully submits that the rejection is improper.

**1. 35 U.S.C. § 101 is to be interpreted based on the claims**

35 U.S.C. § 101 must be applied to the claims, and not the specification, as the focus of examination. For additional support and clarification, Appellant refers the Board to MPEP § 2107, which clearly requires the Examiner to examine the claims under 35 U.S.C. § 101, providing that each rejection must have a claimed element as its specific basis. Appellant first submits that the Examiner has merely applied a rejection to the specification alone, which is insufficient and improper.

For example, but not by way of limitation, the Examiner has directed Appellant to the White House document referring to use of space nuclear reactors. Appellant notes that the claims are not directed to use of space nuclear reactors, and further, that development thereof is not barred by the cited reference. Accordingly, since the claims are not directed to use of space nuclear reactors, Appellant respectfully submits that the Examiner's § 101 rejection is improper.

**2. Claims 4-8 and 14 do not recite non-statutory subject matter**

Appellant respectfully submits that independent claim 14, as well as dependent claims 4, 5, 7 and 8 do not even recite a space nuclear reactor, as cited in the Examiner's reference of record.<sup>2</sup> Therefore, Appellant respectfully submits that the 35 U.S.C. § 101 rejection with respect to those claims is improper.

With respect to claim 6, which recites a nuclear core, Appellant submits that public policy with respect to the claimed nuclear core is not proscribed by 35 U.S.C. § 101. Further, it is submitted that public policy actually supports development of the claimed subject matter for the at least the reasons discussed in greater detail below.

**3. Public policy does not bar, and actually supports the features of claim 6**

Appellant notes that National Space Policy does not prevent the research and development of new space nuclear propulsion concepts, patenting these concepts, nor does the policy prevent the development, production, or even use of space nuclear propulsion. The policy is clearly directed to U.S. individuals or organizations wishing to use such concepts in stable Earth orbit. The policy only states that use of space nuclear reactors requires prior approval. Approval for use of space nuclear reactors is a quite separate issue from patentability, which is the focus of this appeal.

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<sup>2</sup> The White House, National Science and Technology Council, Fact Sheet National Space Policy, 9/19/96, Intersector Guideline, (6) Nuclear Space Policy.

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Further, as explained to the Examiner, the utilization in stable Earth orbit is not the main design purpose of Appellant's invention. However, assuming *arguendo*, even considering a utilization in stable Earth orbit, the National Space Policy foresees the possibility of obtaining exemptions, and the law details the factors that are taken into account for obtaining this use exemption. Whatever applications the Appellant's invention could be used for in the future should not influence the patentability of the invention, nor is an exemption required to obtain a patent on the subject matter.

Also, the Board is directed to U.S. Patent Nos. 6,329,243 and 6,329,587, submitted to the Patent Office in an Information Disclosure Statement (IDS) on December 16, 2002. These references, which use a nuclear based thermal rocket in earth orbit, were granted by the Patent Office. Appellant respectfully submits that if the Examiner's interpretation of 35 U.S.C. § 101 and the 1996 White House reference were accurate, then those patents would have been rejected under 35 U.S.C. § 101. Thus, Appellant respectfully submits that the Examiner's interpretation of public policy with respect to patentability of space nuclear propulsion concepts is incorrect, and additionally, further goes against the PTO's own policy as indicated by the aforementioned patents.

Additionally, in contradiction to the Examiner's position, Appellant provided the Examiner with a Spacenews publication, submitted in a December 30, 2002 Information Disclosure Statement, that includes a statement from the current NASA Administrator that "[t]he single most important effort we are after this year and the years to follow is to push for power generation and propulsion programs like the Nuclear Systems Initiative." Appellant respectfully



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submits that this statement clearly supports Appellant's position that public policy does not proscribe Appellant's claimed invention.

Appellant also respectfully submits that requirement of an approval or authorization does not equate to subject matter being against public policy. For example, but not by way of limitation, pharmaceutical drugs require authorization from the Food and Drug Administration (FDA), which is not required to obtain a U.S. Patent. Also, while weapons and war equipment may be subjected to a Secrecy Order, the subject matter remains statutory. In other words, a particular subject matter is intrinsically statutory or not statutory, and this status does not change as a result of a government approval requirement.

Appellant further submits that the claimed invention need not be operated in Earth orbit. The submission for approval rules for the use in Earth orbit of space nuclear reactors is directed towards the protection of public safety and the Earth's environment. However, Appellant notes that nuclear propulsion can also be used on escape trajectories, for which it is submitted that substantially no risk of return of the nuclear reactor to Earth exists.

The United States Space Policy cited by the Examiner sets no particular limitation for nuclear reactors placed on escape trajectory. The benefits of the propulsion device of the claimed invention are in missions for which a large thrust and a large specific impulse are important, typically manned interplanetary missions, and more specifically, on the escape part of the mission trajectory.

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Accordingly, the present invention can be applied to stages for propulsion in space that come in operation in interplanetary transfer orbit or starting from other planets, and which may contribute to missions, for example (but not by way of limitation), a manned Earth-to-Mars mission (see application page 1, lines 32-37). The United States Space Policy is additionally confirmed by the numerous radioisotope generators flown by United States on an escape orbit including after 1996 (see Annex 1 from the December 16, 2002 IDS).

In paragraph 3 of the February 21, 2003 Office Action, the Examiner asserts that any vehicle launched into space is liable to become Earth orbiting, due to factors such as malfunction during an ascending phase. Appellant again respectfully submits that one application for the disclosed nuclear rocket propulsion device is escape trajectories. Nonetheless, Appellant notes that NASA has certainly reviewed this scenario provided by the Examiner and did not find it sufficiently dissuasive to avoid launching on escape trajectories 17 radioisotope generators since 1969, the latest being launched after 1996, the date of the National Space Policy that the Examiner cites. It is Appellant's understanding that the reactors in these flights contained substances that were highly radioactive, even before any utilization.

The main application of the nuclear rocket propulsion device disclosed in Appellant's application actually features reduced risks as compared to the launch of a radioisotope generator (inducing a risk which was deemed acceptable by NASA). Use of Uranium 235 is one possible choice, but the invention is not limited to this choice. Indeed, Uranium 235 in sufficiently pure form is only weakly radioactive as long as the nuclear engine has not been started, and according to the recommended application, the nuclear rocket engine is started only after the escape

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trajectory is effectively reached. Once the nuclear engine is started, the isotopes produced by the use of the nuclear power device are indeed more dangerous than the initial nuclear fuel, but these create no more risk for the Earth's environment.

Further, the National Space Policy rules only the use of nuclear space power in Earth orbit, but remains silent about the orbiting of an inert nuclear core. As a non-limiting example, if the use of the nuclear core of the Appellant's invention is started only when an escape trajectory is actually obtained, the National Space Policy is not deemed pertinent.

Finally, the United States Space Policy provides that "U.S. Government agency proposals for international cooperation involving space nuclear power systems are subject to normal interagency review procedures." These procedures have led in the past to successful cooperation between ESA and NASA on projects using nuclear electric generators, such as the Cassini/Huygens mission. Appellant respectfully submits that if a decision is made to launch a manned exploration mission to the planet Mars, it is possible that NASA and ESA would be associated to realize this mission, and this mission may require nuclear rocket propulsion. In this matter, Appellant refers the Board to "Intersector Guidelines", Section (1) of the document cited by the Examiner in the 35 U.S.C. § 101 rejection.

Accordingly, for the multitude of reasons listed above, Appellant respectfully submits that based on the claimed invention and a proper interpretation of the statute, that the 35 U.S.C. § 101 rejection is improper.

**B. The claims are in proper condition under 35 U.S.C. § 112, 1<sup>st</sup> paragraph**

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Claims 4-8 and 14 stand finally rejected under 35 U.S.C. § 112, 1<sup>st</sup> paragraph due to alleged lack of enablement, and additionally, the Examiner objects to the specification. For at least the reasons discussed herein, Appellant respectfully submits that the claims and specification are in proper condition under 35 U.S.C. § 112, 1<sup>st</sup> paragraph.

Appellant respectfully submits that the 35 U.S.C. § 112, 1st paragraph enablement rejection appears to be based on the Examiner's assertion that the specification is not enabled. Appellant notes that the claims merely need to be enabled by the specification. Therefore, Appellant respectfully submits that the Examiner has gone beyond the requirements of §112, 1st paragraph, and that the rejection is improper.

The appealed claims are directed to a propulsion device, not to a spacecraft. Further, no value of power or specific impulse is claimed. Therefore, Appellant respectfully submits that the 35 U.S.C. § 112, 1st paragraph rejections<sup>3</sup> directed to such features should be withdrawn, for at least the reasons discussed herein.

Despite the evidence provided in the application and during prosecution thereof, the Examiner asserts that the prohibitive weight of a nuclear power reactor associated with safety devices make them unsuitable for flight applications. Appellant submits that the Examiner's basis would bar any Patent in the field, as well as development of related technology.

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<sup>3</sup> See the February 19, 2003 Office Action at paragraph 6 for details of the rejection.

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Since the Appellant does not claim a device having a particular performance as to the ratio weight/power, no burden commensurate with the scope of the claims should be placed on Appellant. Additionally, it can be seen when reading the above-mentioned U.S. Patent No. 6,367,243, which gives no description at all of the nuclear thermal rocket, but makes reference to the Borowski article, that the Examiner apparently goes much beyond the legal requirements of 35 U.S.C. § 112, 1st paragraph in the matter of enablement in comparison to Appellant's application.

As examples of granted U.S. patents which have met the enablement requirements of 35 U.S.C. § 112, 1st paragraph without meeting the requirements set forth by the Examiner for the present application, Appellant refers the Board to U.S. Patent No. 5,636,512 for a "Nuclear Rocket feed System incorporating an auxiliary power cycle" (submitted in the December 16, 2002 IDS for the Examiner's consideration). To the best of Appellant's knowledge, the device of '512 patent has never flown, and all parts of that invention have never been tested together on the ground (a comprehensive test is not possible with the currently existing ground means). Still, the patent description, which contains some elements of a nature similar to the Appellant's description, has been considered as sufficient for enablement by the USPTO.

As among others, the grant of the above-referenced U.S. Patents clearly demonstrates the level of enablement generally required in this technical field, as related to the claims of those references. For the present application, the description goes beyond what is encountered in either of the two above-mentioned patents.

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Such a discrepancy of treatment between applications is not understandable and inevitably raises the question of the proper standard of requirement. In the February 19, 2003 Office Action, paragraph 4, the Examiner refused to comment on these points.

Below, the Appellant summarizes the enablement of the invention, and provides additional clarification to the Board.

**NUCLEAR CORE**

As noted above, only claim 6 recites a nuclear core. Therefore, it is Appellant's position that the final rejection based on 35 U.S.C. § 112, 1st paragraph as applied to the nuclear core should only be directed to claim 6. In the context of claim 6, Appellant provided the Examiner, and now provides the Board, with the following response.

Heating of a gas flow by a nuclear core has been demonstrated experimentally by the NERVA ground experiment at a level of power, temperature and mass flow rate comparable to the conditions to be encountered in the applications sought by the invention. The results of the actual NERVA-1 testing were obtained with the technology available about 40 years ago and are considered to be related art, as discussed in the previous responses to the Examiner. Among the disclosed results was the explanation of the value of 0.2 MW/kg, which is accepted in the technical field of the present invention since the NERVA program was fulfilled nearly 40 years ago.

However, to reduce the weight, the preferred embodiment contemplated by inventor and according to his best knowledge has been enabled as required by § 112. It is a particle bed

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reactor design, but this preferred embodiment is not the only possible embodiment of the claimed invention. Significantly, there is no claim that is specifically directed to such a reactor, and therefore, this should not serve as a basis for the rejection, especially since as mentioned in the specification, a conventional reactor may be used even if the weight will be higher, but is by no way prohibitive as the Examiner contends, in spite of the evidences and figures that have been provided during prosecution of the application.

Additionally, Appellant respectfully submits that the design of a particle bed reactor has been considered by the U.S. Patent Office as enabled in the following U.S. Patents : 3,992,258, 3,928,638, and more particularly 4,759,911 (submitted in the December 16, 2002 IDS).

More specifically, the present application discloses particle bed reactors having a mass ratio of 0.3-0.5 MW/kg and a core temperature of 3000 K. The conservative figures cited in the specification are even obtainable with conventional reactors such as the NERVA- 1 engine dating back to the 1960's. Appellant respectfully submits that it is clear that the figures given in the present application are conservative and not speculative, thus avoiding the use of figures of a speculative nature for enablement. These figures represent the inventor's best knowledge on the subject, precisely as required by § 112.

The Examiner also points out that no nuclear rocket propulsion device according to the Borowski design has yet been tested in space operation. Such proof of feasibility of nuclear powered rockets goes beyond the legal requirements for the enablement of a Patent (see U.S. Patent No. 6,367,243 to NASA, which also cites Borowski as a basis for enablement), for the

claimed invention. Appellant notes for the record that the Examiner describes the above comment “[t]he Examiner also points out that no nuclear rocket propulsion device according to the Borowski design has yet been tested in space operation” as Applicant’s admission in paragraph 6 of the February 19, 2003 Office Action. Appellant submits that this was the Examiner’s assertion, not necessarily the Appellant’s, and that rather, the statement made by Appellant in the December 30, 2002 response was directed to indicating that the proof of feasibility in that instance went beyond the legal requirement for patentability.

#### **BRAYTON CYCLE**

Appellant submits that the hydrogen part of the circuit in the claimed invention is enabled on the same basis as for the aforementioned U.S. patents. The same gas heating process also applies to helium, even if the thermodynamic properties of helium are slightly different from those of hydrogen. Further, it is submitted that heating helium is even easier when considering its absence of chemical reactivity and of metal fragilisation effects. Furthermore, USPTO has already considered that the heat exchange technology from a nuclear core to a helium flow is enabled since it issued U.S. Patent No. 4,756,873, and especially U.S. Patent No. 4,759,911, which relates to a gas cooled particle bed reactor for multi megawatt space power and propulsion applications (see col. 1, lines 10-15).

The generation of mechanical power in a BRAYTON gas cycle is common knowledge. which does not require additional enablement for its principle. This can be found in general thermodynamics textbooks. Its application in a space environment, combined with a nuclear



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power reactor (as only recited in claim 6), has already been described and enabled in U.S. Patent No. 5,636,512 (see col. 2, lines 25-27). Its application for high power electrical generation has been described in the U.S. Patent No. 4,756,873, which features a thermodynamic cycle using helium and identical in principle to the Brayton cycle.

As previously explained, the capacity to reach a compression ratio of 82.2 is not speculative. The Examiner recognizes the reality of the Space Shuttle Main Engine turbopump, which delivers a pressure of 426 bar. However, the Examiner considers the example not relevant, because turbopump is not part of a Brayton cycle. As we did with the Examiner, the Appellant draws the attention of the Board to the fact that the capability of a pump to deliver a certain mass flow of a gas at a given pressure does not depend on whether that pump is part of a Brayton cycle.

The Examiner also contends that the specification does not enable a flight capable exchanger operating at temperatures higher than 20000K and at high pressure. However, in table 5.2 of the CINNAMON document cited concerning the NERVA-1 program, it was already known in the 1960's to heat a gas of low molecular weight (H<sub>2</sub>) at high temperature (25000K) and high pressure (1000 psi or 67 bars), in a nuclear power reactor of 1520 MW (the structure of the NERVA-1 rocket is shown in figure 14.6 of the SUTTON reference provided by the Examiner). Note also that the power/weight ratio of this NERVA-1 engine was 0.19 MW/kg.

In 1992, for most of the motor components, CINNAMON mentions that the technology readiness was 5 or 6.6, corresponding to a level immediately preceding a flight engine.

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Conversely, the purpose of SUTTON is to give prospective figures for future development, not to give actual figures for prior art, whereas CINNAMON gives actual figures for the experimental NERVA-1 engine. Note also that U.S. Patent No. 5,636,512 considers heating the hydrogen at temperatures typically in excess of 4000 F (> 2200 C) and withdrawing heat with an heat exchanger (recuperator 20) (see column 4, lines 46-48), so this type of technology is to be considered as well established in the related art.

The heating of a gas of low molecular weight only by heat transfer from a nuclear reactor has been demonstrated in the previous paragraphs. Hence, the state of the art teaches how to produce helium at 2000 K and at the appropriate pressure. The fact that helium is a noble gas is an advantage since it cannot react chemically with the engine.

As indicated at the end of paragraph 6 of the February 19, 2003 Office Action, the Examiner is skeptical of the feasibility of a nuclear core with a temperature of 3000K. Appellant submits in response that Borowski, who is a well-known U.S. specialist in the field, considers this value as a reasonable goal for a particle bed reactor and also quotes in the same paper Russian reactor experiments (using a different design but with comparable energy density), which demonstrated 3100K during one hour. Nonetheless, for the purpose of this Appeal, Appellant should not need to justify nor even discuss the feasibility of a core working at 3000K, because the core in the present invention is assumed to work at 2000K, as stated in all previous responses provided to the Examiner, and as specifically disclosed by the patent application. Moreover, this temperature is not part of the claims.

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Further, as also indicated in the same paragraph 6 of the Office Action, the Examiner once again considers that the nuclear reactor for space propulsion application is not enabled by Cinnamon or by any one else, because even though nuclear rockets were realized and tested on ground with NERVA, they were never tested in space. The Examiner considers that only the realization of the invention and its actual operation in space is proof of the existence of sufficient enabling teaching. Appellant submits that this is beyond the requirements of enablement.

**GENERATION OF ELECTRICAL POWER**

In the objection to the specification, the Examiner questions the frequency of the electrical power to be generated as compared to the estimated speed of rotation of the turbopump. As provided to the Examiner, the Appellant provides the Board hereafter further complementary information on one of the preferred variant for the design of the alternator according to the invention.

The usual speed of rotation for a turbopump is of the order of 30,000 revolutions per minute. The direct use of an alternator on a shaft rotating at this speed provides power at a frequency, which is a multiple of 500 Hertz, the multiplier depending on the number of poles of the alternator. With 20 poles, the frequency of the power output can be obtained at 5 kHz. A frequency multiplication by a factor 12 would therefore be required to obtain the order of magnitude of 60 kHz, which may be obtained in a simple way (i.e., by electronic conversion of frequency). The drawbacks of industrial converters disclosed in the patent description (i.e., poor efficiency and heavy weight) do not apply to this conversion, because in the case of industrial

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application the power to be converted is provided at 50 Hz, whereas in the case of the invention the power at the exit of the alternator coils is at a multiple of 500 Hz (e.g., at 5 kHz). To obtain 60 kHz, the multiplication factor is 12 (and a much better efficiency) instead of 1200 for conventional conventions of poor efficiency. The higher the multiplication factor, the lower the efficiency.

As described, the alternator is cooled at cryogenic temperature. This makes losses much lower as compared to usual industrial applications. In industrial applications, where the power is initially provided at 50 Hz, it is known that frequency converters present a large amount of mass and also suffer from the drawback of poor energy efficiency when designed for an industrial induction heating system. The general idea of the text was the avoidance of a complicated frequency converter and not the avoidance of any converter.

**C. The claims are novel under 35 U.S.C. § 102(b)**

Claim 14 stands finally rejected due to alleged anticipation under 35 U.S.C. § 102(b) over Curtiss et al. (hereafter "Curtiss"). Appellant respectfully submits that Curtiss fails to disclose all of the claimed combination of features, as required for an anticipation rejection under §102. For at least the reasons herein, Appellant submits that the rejection is improper.

The Examiner finally rejected claim 14 over Curtiss stating that the alternating current in coil 12 inherently heats the ejected gases (see, for example, the last sentence of paragraph 10, page 8 of the February 19, 2003 Office Action). Curtiss uses Lorentz forces to generate thrust,

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namely magnetohydrodynamic propulsion. For this, the plasma must be brought at high temperature to be ionized to develop Lorentz forces.

In the Appellant's claimed invention, the gas in the nozzle is heated by induction, and then heat is converted into additional thrust by thermal expansion in a downstream part of the nozzle. Accordingly, the gas velocity at the exit of the downstream nozzle is much higher than the velocity at the exit of the induction coil, due to this thermal expansion, which creates additional thrust.

In Curtiss, the propulsion is of a magnetohydrodynamic nature. The exit of the coil is the exit of the Curtiss engine. Therefore, the velocity of the gas at the exit of the coil is the velocity of the gas at the exit of the Curtiss engine. This is obvious from the figure 1 of Curtiss: there is no nozzle downstream of the coil, which is an essential difference with the claimed invention.

The absence of the downstream nozzle demonstrates that Curtiss harnesses a mode of propulsion which is fundamentally different to the one used by Appellant's invention, namely a magnetohydrodynamic propulsion i.e. the use of Lorentz forces) instead of a thermal expansion propulsion (i.e. the transformation by a nozzle of the thermal energy of a gas into translational energy of this gas).

Appellant also submits that in Curtiss, the power source is pulsed according to a duty cycle ("On" for 1 millisecond and "Off" for 9 milliseconds), which is mandatory for this type of propulsion (see Dailey column 5, lines 8 —26 and figure 3 and more particularly column 5, lines

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12 -14: “with a symmetrical current waveform, no net thrust would be generated, since forward thrust would equal reverse thrust”).

Conversely, according to the claimed invention as recited in independent claim 14, the power is transformed into heat by induction and said heat generates the thrust, which is not the case in Curtiss. Therefore, Appellant respectfully submits that the anticipation rejection of claim 14 is improper.

**D. The claims would not have been obvious under 35 U.S.C. § 103(a)**

Claims 4 and 5 stand finally rejected due to alleged obviousness under 35 U.S.C. § 103(a) over Curtiss in view of Oberly (U.S. Patent No. 4,739,200), and claims 6-8 also stand rejected under §103 over Curtiss and Oberly in view of Appellant's background art (hereafter “background art”). Appellant respectfully submits that the proposed combination of references fails to disclose or suggest all of the claimed combinations of features, as required for a prima facie obviousness rejection under §103. For at least the reasons herein, Appellant respectfully submits that the §103 rejection is improper.

Claims 4-8 depend from independent claim 14. Appellant respectfully submits that the dependent claims are allowable for at least the same reasons as independent claim 14, from which they depend. Additionally, Appellant respectfully submits that claims 4-8 are also allowable for at least the additional reasons discussed in greater detail below.

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The Examiner asserts that for claim 4, "it would have been obvious to one of the ordinary skill in the art at the time of the claimed invention to cool the Curtiss generator with a propellant fluid as taught by Oberly".

A fundamental feature of the cooling fluid used by Oberly is to be cryogenic. This feature is absolutely necessary to minimize the ohmic heat loss in the electric generator. On the contrary, Curtiss teaches that the propellant gas provided at the entry of the funnel must be ionisable. Appellant respectfully submits that one skilled in the art could have easily deduced that the gas temperature will be high at the entry of Curtiss apparatus, for it to be ionized. Appellant does not find it possible to reconcile both constraints of the references, and thus, the references are believed to teach away from one another, which is improper for a §103 combination. Further, the Examiner's assertion that liquid hydrogen/liquid oxygen propellants are conventionally used in rockets does not help to solve the above contradiction. Neither does the Examiner's most recent statement in paragraph 12 of the February 19, 2003 Office Action that Oberly's invention is applicable for aerospace applications. Accordingly, Appellant respectfully submits to the Board that the §103 rejections should be withdrawn.

The Examiner finally rejected claim 5, which relates to the use of additional combustion upstream of the coils, again on the basis of Curtiss and Oberly. Appellant respectfully disagrees, since he does not see any chemical reaction in Curtiss, while in Oberly the liquid hydrogen/oxygen combustion is only used to drive a turbine, which powers the alternator, and not to generate any thrust. Appellant submits that in the claimed invention, the combustion only

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increases the thrust, and the generator is powered only through a BRAYTON cycle using the nuclear core as heat source.

The Examiner rejects claims 6-8 on the basis of Curtiss (Appellant has explained above why he disagrees with the Examiner's position) and on the basis of the fact that following the NERVA program, nuclear cores were state of the art for space propulsion applications. This basis for rejection contradicts previous statements of the Examiner<sup>4</sup> which considers that "the NERVA program never produced a flight able engine", and more generally "the prohibitive weight of nuclear reactors and the associated safety devices makes them unsuitable for flight application". Appellant submits that the Examiner's assertions are not related to the object of the claims 6-8, reciting a thermodynamic cycle provided for the thermal engine, which mechanically powers the alternator and pumps, and for the propellant itself. Further, the fact that heat pumps and heat exchangers are state of the art does not modify the pertinence of the argument.

The present Brief on Appeal is being filed in triplicate. Unless a check is submitted herewith for the fee required under 37 C.F.R. §1.192(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

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<sup>4</sup> For example, see paragraph 6 of the February 19, 2003 Office Action.



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The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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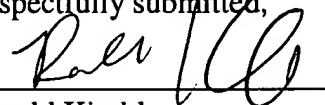
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Date: September 22, 2003

Respectfully submitted,



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## APPENDIX

### CLAIMS 4-8 and 14 ON APPEAL:

4. A device according to claim 14, wherein at least one of said propellant fluids feeds at least a first heat exchanger for cooling the electricity generator.

5. A device according to claim 14, wherein the injection chamber has a first inlet for a first propellant fluid, and a second inlet for a second propellant fluid which enters into the injection chamber and reacts chemically to produce heat.

6. A device according to claim 5, having a nuclear core which constitutes a heat source for a heat engine which is coupled to the electricity generator, and wherein at least one of said propellant fluids is supplied in cryogenic form and passes through at least a second heat exchanger to constitute a heat sink for the heat engine.

7. A device according to claim 6, wherein at least one of said propellant fluids feeds at least a third heat exchanger which is heated by said nuclear core and which is disposed downstream from said second heat exchanger.

8. A device according to claim 6, wherein the heat engine drives at least one pump for circulating and pressurizing at least one of said propellant fluids.

14. A propulsion device comprising; an injection chamber for at least one propellant fluid, said injection chamber disposed upstream from a gas injection nozzle, an inductive coil having at least one loop and surrounding a zone of the injection nozzle to heat the ejected gases by induction, a high frequency electricity generator providing power to said inductive coil with alternating current, said power being transformed into heat in the ejected gas by induction, said

heat generating added thrust by gas expansion in a diverging section of said nozzle disposed downstream of said inductive coil.